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BELLADONNA AND HYOSCYAMUS.[1]

By EDWIN L. NEWCOMB, College of Pharmacy, University of Minnesota.

(*Continued from December, 1914.*)

PART II—MORPHOLOGICAL STUDIES.

The available outer morphological descriptions of *Atropa Belladonna* and *Hyoscyamus niger* are quite complete and but little can be added. It was noted that a few of the Belladonna plants were especially characterized by being very hairy, and such plants were found growing mostly in plots which had been fertilized with cyanamide or sodium nitrate.

Excellent anatomical descriptions of Belladonna and Hyoscyamus have been prepared by various workers, but some exceedingly characteristic features appear to have been omitted. Microscopical examinations which I have made from time to time as the plants grew revealed the presence of distinct branching hairs on *Atropa Belladonna, Hyoscyamus niger,* annual and biennial, and on *H. albus.*

The branching hairs in *H. niger* and *H. albus* are very much alike, probably identical, while those found on Belladonna were of the same general forms, but usually much shorter and not so thick at the base. A number of different types of branching hairs were observed, as is indicated by the illustrations.

In Hyoscyamus these hairs occur on the basal margins of the sessile leaves and on the edges of the petioles of the petioled leaves,

[1] Presented to the Philadelphia College of Pharmacy for the degree of Master in Pharmacy in course.

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being most abundant on the latter. They are present on the seedlings of a few months' growth, as well as on the mature plants. They may attain a total length of as much as five millimetres, and a width at the base of from seventy-five to eighty microns. They are richly protoplasmic when in the living condition, and they have thin, non-lignified walls, the walls being from one to two and one-half microns thick. The stalks (*i.e.*, the cells below the branching) vary in length from one hundred to twenty-seven hundred microns, and usually consist of from one to five cells, occasionally more. The branches, of which there may be one or two, rarely three, consist of lateral prolongations of cells from the main hair or of from one to ten or more distinct cells arising from the joints or sides of cells in the main axis. The apices of the branching hair are obtuse or rounded, occasionally enlarged and spherical. The latter form does not appear to contain oil, but is richly protoplasmic.

In Belladonna branching hairs were observed on each of a large number of plants examined, the selection of plants representing some from each lot wintered by different methods. The branching hairs on Belladonna are mostly found on the young shoots, as the plant begins growth in the spring and they are located on the same part of the leaf as found in Hyoscyamus. The greatest length of a branching hair observed in Belladonna was thirty-four hundred microns, and the greatest width at the base seventy-eight microns. The form of branch represented by the lateral prolongation of a cell is only occasionally found in Belladonna and the length of the individual cell is usually somewhat less than in Hyoscyamus. In other respects the branching hairs of Belladonna resemble those of Hyoscyamus. The branching hairs in Belladonna are not confined to those plants which are especially hairy.

The young, rapidly-growing leaves of *Nicotiana tabacum* and *N. repanda* also possess branching hairs which closely resemble those of Belladonna and Hyoscyamus, and which are quite different from any which have heretofore been described.

The broken-joint portions of these branching hairs I have observed in commercial Hyoscyamus powdered in my laboratory. They are more abundant in drug which represents basal first-year leaves than in flowering tops. In either case their detection is difficult, due to the thin, delicate structure of the hairs, which results in their breaking up more or less completely. The branching hairs

are comparatively fewer in Belladonna than in Hyoscyamus, and practically one can but rarely observe them in the drug Belladonna.

Calcium oxalate, occurring as sphenoids in Belladonna and as single or twin monoclinic prisms, or occasionally rosette aggre-

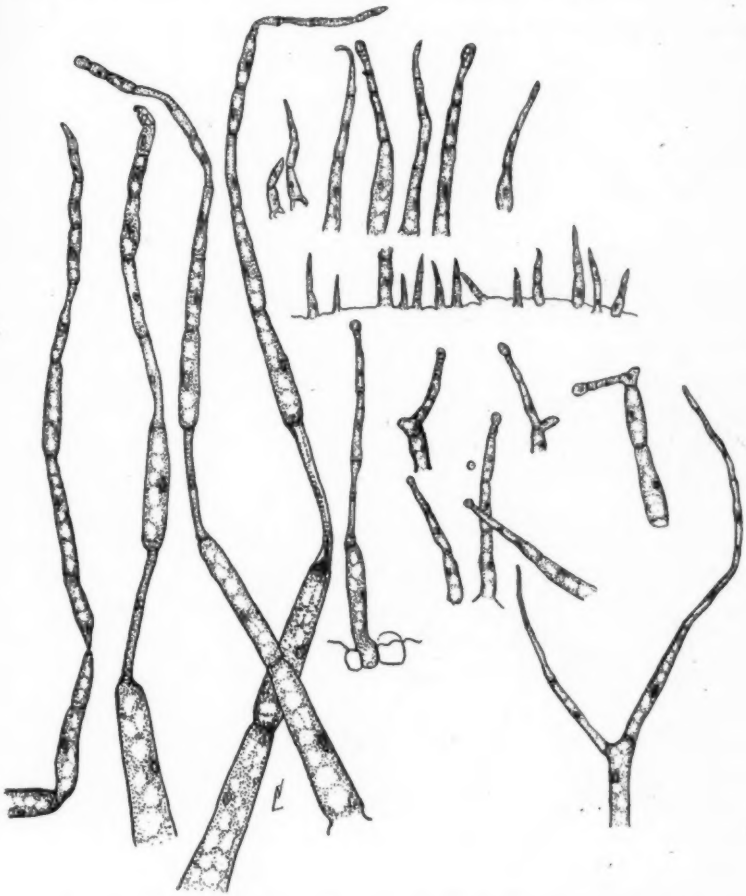

FIG. 6.—Various forms of hairs occurring on a single leaf of *Hyoscyamus niger*.

gates, in Hyoscyamus, has been held for some time as a means of distinction between these two plants. In the last edition of the German Pharmacopœia attention is called to the presence of sphenoids of calcium oxalate in Hyoscyamus, and quite recently Anselmino and E. Gilg stated that the crystal sand described in the German Pharma-

copœia appears only in young leaves, and is, besides, too rare to serve as a basis of recognition. I have studied the presence of these crystals of calcium oxalate during the entire life history of Hyoscyamus, and I find that sphenoidal crystals occur during all stages of growth. The sphenoidal crystals I have found in the young leaves and also in the mature leaves. The sphenoidal crystals occur

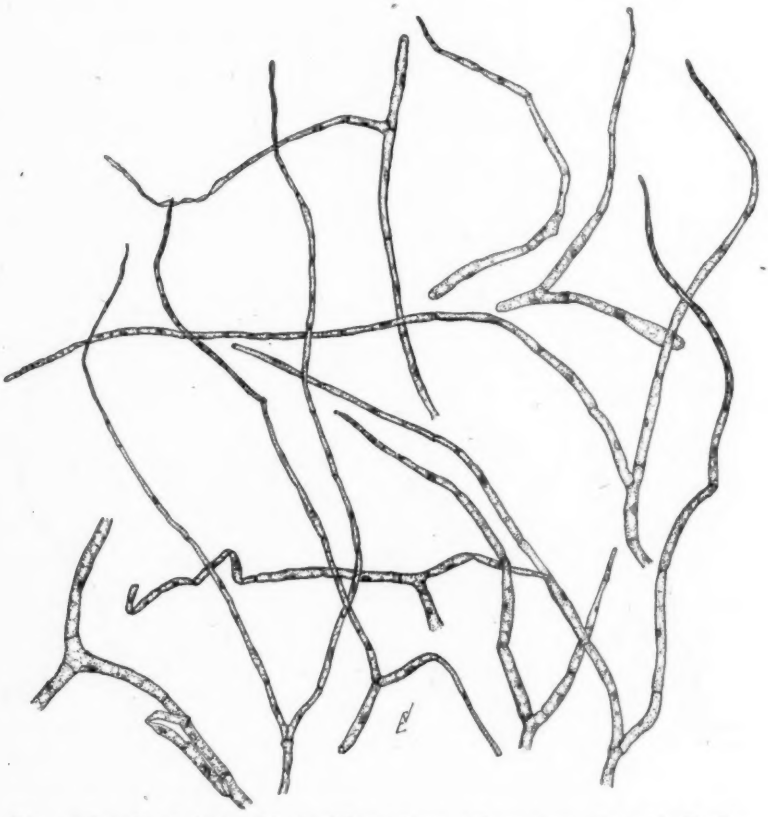

FIG. 7.—Branching hairs found in the different forms of *Hyoscyamus niger* and in *H. albus*.

in a few cells of the parenchyma layers immediately surrounding the vascular bundle of the midrib. The average transverse section of a mature leaf contains from ten to fifteen cells with sphenoids. The crystals vary in size from three to ten microns long. The number of these crystals in powdered Hyoscyamus is not great, but they are always present.

The stems, leaves, and flowers of *Hyoscyamus niger* contain the cell-sap coloring principle anthocyanin. Warm aqueous extractions of the corollas yield solutions of a blue color, which give a deep pink with dilute acids and a rich grass-green color with lime water. When strong alkalies are added to a solution of the coloring principle

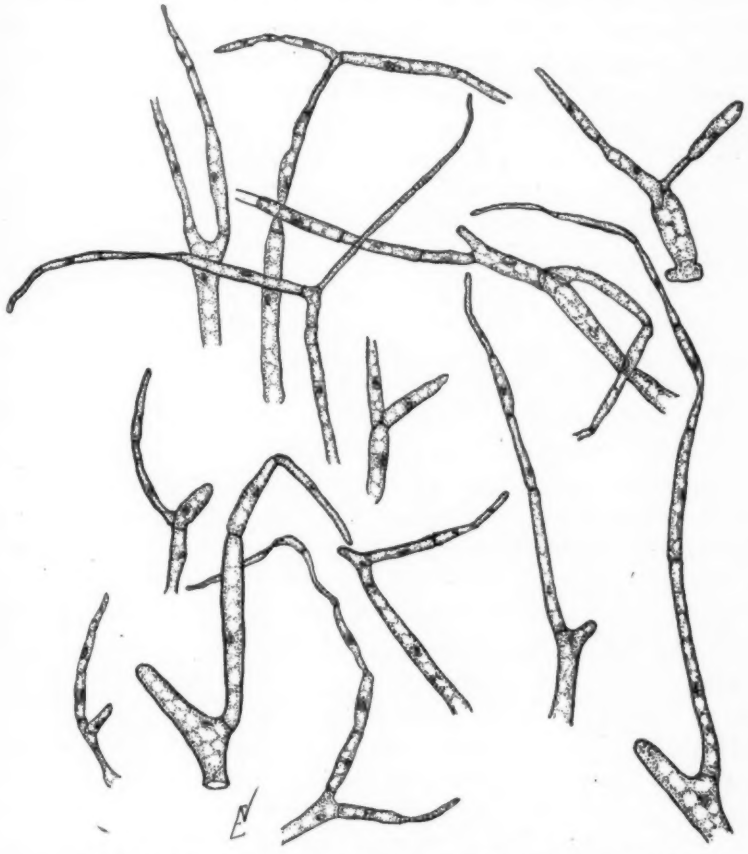

FIG. 8.—Branching hairs found in the different forms of *Hyoscyamus niger* and *H. albus*.

a dark green evolves, quickly changing to yellow and yellowish-brown. *Hyoscyamus albus* does not contain this cell-sap coloring principle, and will not give any of the above reactions. Very small seedling plants of the two species of Hyoscyamus mentioned above may be differentiated by making longitudinal sections of the young petioles

and mounting in dilute hydrochloric acid, which with *H. niger* imparts a deep pink or rose-red color to the many cells containing anthocyanin. The young seedlings may also be differentiated, although less accurately, by noting the purplish hue of the petioles and buds of *H. niger.* A few grammes of the official leaves and flowering tops of *H. niger,* when powdered and shaken for a few moments with hot water, impart a faint bluish color to the water. If the mixture is filtered and dilute hydrochloric acid added to the filtrate, it becomes pink. The intensity of the color depends upon the care which has been taken in the collection and drying of the drug and upon the amount of basal leaves or foreign matter.

The purple color of the corolla, the fruit, and of the stems of *Atropa Belladonna* gives the same reactions as anthocyanin from *Hyoscyamus niger.* The extraction of the coloring principle from Belladonna flowers is slow, and other extractives tend to cloud the reactions. The tests with Belladonna are best made by placing fragments of the corolla in the reagents, either in test-tubes or on microscopic slides.

The pollen grains of Hyoscyamus are quite characteristic, being flattened and triangular, from forty to fifty microns broad and from thirty-four to forty microns thick. In outline they appear either rounded, elliptical, or triangular, depending on the point of vision. The surrounding membrane of the pollen grain consists of two parts, a continuous layer of intine and an outer layer of exine which is usually ruptured over the angles at the maturity of the grain, leaving thin places for the development of the pollen tube. The exine layer is quite smooth and yellowish in color. Occasionally pollen grains may be observed with the pollen tube protruding through one of the thin places. The number of pollen grains found in the powdered drug Hyoscyamus is proportional to the amount of stem, first-year basal leaves, and other extraneous matter ground with the flowering tops. If powdered Hyoscyamus is prepared from flowering tops with a somewhat uniform amount of stem, the number of pollen grains is fairly constant. This is due to the fact that the flowering tops seldom have less than two or more than four blossoms mature at one time. In a number of commercial samples of Hyoscyamus, consisting of the flowering tops with a minimum amount of stem, I have found, after powdering, the following numbers of pollen grains:

No. of sample.	Weight of sample.	No. of pollen grains.
A	5 mg.	931
B	5 mg.	766
C	5 mg.	890
D	5 mg.	986
E	5 mg.	1045

A commercial sample consisting entirely of the basal leaves of the biennial Henbane, when powdered and examined, showed only occasional pollen grains in five-milligramme portions. A commercial sample which by garbling was found to consist of eighty-nine

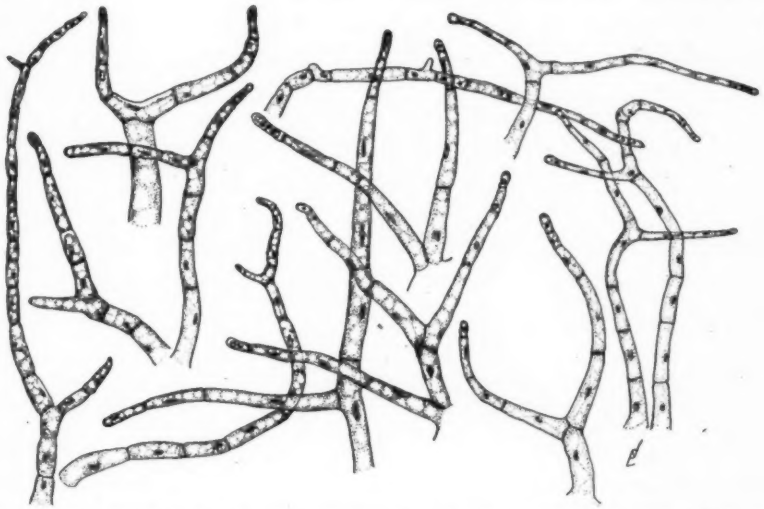

FIG. 9.—Branching hairs found on the young growth and on the new shoots of *Atropa Belladonna*.

per cent. basal leaves and eleven per cent. of flowering tops, when powdered and examined in five-milligramme portions, was found to contain from seventy-five to one hundred pollen grains in each portion. From these observations it is evident that the number of Hyoscyamus pollen grains in a sample of powdered Hyoscyamus indicates the amount of flowering tops in the drug which was powdered.

ALKALOIDS AND ASH IN HYOSCYAMUS.

Numerous results on the amount of alkaloids in Hyoscyamus have been published, but for the most part these results have been based upon the examination of commercial drug material, and, while the assays have probably served to indicate, in a general way, the medicinal value of such samples, they cannot be accepted as scientific

data upon which to base conclusions concerning what species, varieties, or parts of the plant are most valuable medicinally. Especially is this true when the facts concerning the natural hybridization of Hyoscyamus are considered. Again, practically nothing is known of the methods of culture, drying, storage, etc., of most of the various specimens reported upon. No attempt has been made thus far to study the alkaloids in the plants that I have cultivated, but the pure cultures now being developed will be examined in this respect. Süm-Jensen reported on a study of the amount of alkaloids in carefully-collected samples of *Hyoscyamus niger,* and the nature of the work done seems of sufficient importance to call attention to it at this time. The following table gives his results:

Part of plant.	Total alkaloids.		
Root of biennial plant.....	.155	.16	.17
Leaves of biennial plant, first year...	.059	.066	.069
Leaves and tops, second year.....	.065	.067	.068
Leaves and tops, annual.....	.064	.068	.070

Carefully-cleaned leaves, collected in the medicinal plant garden, and commercial samples of Hyoscyamus have been examined for the per cent. of ash. The following table gives the result of this work:

	Part of plant.	Source.	Per cent. of ash.
1.	Basal leaves, 89 per cent. / Flowering tops, 11 per cent.	Commercial sample	21.69
2.	Basal leaves, 89 per cent. / Flowering tops, 11 per cent.	Commercial sample	19.07
3.	Flowering tops	Select commercial sample	9.68
4.	Flowering tops	Select commercial sample	9.48
5.	Basal leaves, first year	Medicinal plant garden	16.02
6.	Basal leaves, first year	Medicinal plant garden	16.17
7.	Flowering tops	Select commercial sample	9.54
8.	Flowering tops	Select commercial sample	9.06

The results of work like the foregoing on Belladonna and Hyoscyamus indicate that a complete understanding of vegetable drugs can come *only* after thorough studies have been made of the plants yielding drugs. Such studies necessitate the more or less continuous observation of the growing plant throughout its life, and also much experimental work along physiologic and pharmacognostic lines. During the time that the work embodied in this paper has been in progress I have taken a large part in planning and constructing a medicinal plant laboratory, wherein the origin and nature of vegetable drugs may be, and is, studied in connection with the medicinal plant

the work embodied in this paper. Along with the development of this medicinal plant laboratory, although beginning somewhat earlier, I have developed a medicinal plant garden, wherein much of the material for the work embodied in this paper has been grown. All that is embodied in this paper, including the illustrative material, represents my own work.

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THE DEVELOPMENT OF THE SUGAR INDUSTRY.*

By C. A. BROWNE.†

In previous lectures before the students of this course, the subjects of sugar manufacture,[1] the production of raw sugar in some of our colonial possessions[2] and the utilization of by-products of the sugar industry[3] were treated. These have all been printed in the *School of Mines Quarterly,* and to save time and avoid repetitions I refer you to this publication for many details. As a topic for

* A lecture in the Department of Chemistry, Columbia University, April 17, 1914, and reprinted from *The School of Mines Quarterly,* April, 1914, pp. 223–241.

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[1] *School of Mines Quarterly,* April, 1911.

[2] *Ibid.,* January, 1913.

[3] *Ibid.,* July, 1913.

this year's lecture, it occurred to me that a short account of the development of the sugar industry would be of interest. The historical study of a subject is usually most instructive; it fixes in our minds the progress of the past and enables us to forecast the possibilities of the future.

Sugar is derived, at present, principally from two plants, the sugar cane and the sugar beet. The production of sugar from the maple, palm, and other minor sources, is of comparative insignificance and will not be touched upon. For the year 1912–1913, the total production of cane and beet sugar for the whole world was 18,144,638 tons, of which 9,178,574 tons was cane sugar and 8,966,064 tons was beet sugar, being in the proportion of 50.5 per cent. for cane and 49.5 per cent. for beet sugar. The production of sugar in order of importance, for the ten leading countries during that year, was as follows:

SUGAR PRODUCTION OF THE WORLD.

Country.	Production of sugar, tons.
1. Germany	2,700,913 (beet)
2. British India	2,583,600 (cane)
3. Cuba	2,428,537 (cane)
4. Austria	1,901,615 (beet)
5. United States and Colonies	1,770,837 (1,146,773 cane) (624,064 beet)
6. Russia	1,374,500 (beet)
7. Java	1,331,180 (cane)
8. France	960,900 (beet)
9. Holland	316,177 (beet)
10. Belgium	298,584 (beet)

The consumption of the world's output of sugar in the ten leading countries during the same year was as follows:

SUGAR CONSUMPTION OF THE WORLD.

Country.	Gross consumption, tons.	Consumption, per capita, pounds.
1. United States	3,743,150	85.40
2. British India	3,225,000(?)	2.40(?)
3. England	1,966,690	95.52
4. Germany	1,470,000	48.95
5. Russia	1,454,700	24.33
6. France	767,430	43.41
7. Austria	653,300	28.12
8. Turkey	204,000	19.84
9. Italy	166,900	10.76
10. Spain	142,610	16.24

The home of the sugar cane, as of many other of our cultivated plants, is India. We find the cane mentioned in earliest Sanskrit writings and it seems to have thrived there from time immemorial. The Greek soldiers of Alexander the Great found the cane growing in India at the time of their conquest of Asia in 327 B.C., and reports of the sugar cane, which they brought home, are among the first historical accounts that reached Europe. It is doubtful, however, whether sugar was manufactured from the cane so early as this. The cane was at first simply eaten, just as in primitive countries at the present time, the expressed juice being used also as a beverage or fermented into a kind of wine. At a later period cane juice seems to have been evaporated in the household for making preserves or sweetmeats, and the sweet crystalline deposits which separated from the evaporated juice probably gave the early people of India their first ideas of sugar making. It is not until after the third century of the Christian era that we find in old Chinese writings the first mention of sugar as a commodity of commerce, although it is probable that sugar was made on a small scale long before.

From its native home in India the sugar cane was carried eastward and westward. It was introduced by the natives through the islands of the East Indies, the Philippines, and the rest of that great archipelago. Thence it was carried to Samoa, Tahiti, and the other islands of the southern Pacific, and from there it was transported by daring native navigators to the Hawaiian Islands, where it was found growing by Captain Cook at the time of his voyage of discovery. The Pacific Islanders, however, cultivated the sugar cane simply for the purpose of eating its stalk or drinking its juice; none of them ever advanced far enough to manufacture sugar, and for the development of this art we must turn to the western nations.

The first nation to transport the sugar cane westward was naturally the Persians, whose country adjoined India. The Persians not only grew cane for eating, or for its juice, but also made some progress in sugar manufacture. Traces of Persian influence survive to the present day, as, for example, in our word candy, which is derived from the Persian *kand,* meaning hard or refined sugar. For raw sugar the Persians had a different word, *schakar,* the same as our word sugar, a word very much alike in all languages, and derived from the original Indian or Sanskirt word *sakkara.*

It is to the Arabs, however, that we owe the introduction of the sugar cane to the nations of Europe. The sympathy of Arabian

Caliphs with agriculture, the sciences, and the useful arts was one great means of preserving the civilization of the ancient East and transmitting it to Europe. The Mohammedans, in their conquests of Persia and India, came early in contact with the sugar cane and transplanted it to the conquered nations of the west. Improvements in cultivation and irrigation were introduced, and the familiarity of Arabian alchemists and physicians with the process of recrystallizing salts led them, no doubt, to apply the same principle in refining sugar. In the books of the great Arabian scientist Avicenna, who lived about the year 1000, we find sugar described as we now know it, and from this time onward the use of sugar was destined to increase, until from one of the rarest and most expensive articles of luxury it became one of the cheapest and most abundant commodities.

From the valley of the Tigris and Euphrates the Arabs carried the sugar into Egypt and Palestine and, with the extension of their conquests westward, transported its culture to Asia Minor, northern Africa, to the Mediterranean islands of Cyprus, Rhodes, Crete, Malta, and Sicily, and finally to the continent of Europe itself, where it was widely cultivated in southern Spain, where its culture survives to the present day.

One great factor which favored the introduction of sugar to Europe was the Crusades. Readers of Joinville's chronicle will remember how the crusaders found the sugar cane growing in Palestine and, like the soldiers of Alexander 1500 years before, brought back stories of the wonderful reed whose sweet juice invigorated them after weary conflict or march. One of the chief benefits of the Crusades was the expansion which followed in the commerce between Asia and Europe, the chief city for the importation of Eastern commodities being Venice. The Venetians improved the art of refining sugar, which they learned from the Arabs, and during all of the fourteenth and fifteenth centuries held a monopoly for supplying Europe with sugar.

With the increase in consumption of sugar, the areas for the cultivation of the sugar cane widened. In 1420 the Portuguese transplanted the cane from Sicily to Madeira, and shortly after this time it began to be cultivated in the Canaries, Azores, and other western islands.

Immediately after the discovery of America followed the transplanting of sugar cane to the western hemisphere. Columbus on

his second voyage, in 1493, carried with him sugar cane from the Canaries to San Domingo. The cane thrived so well in its new surroundings that the sugar industry spread rapidly to Cuba, Mexico, Brazil, and other provinces of the New World. In Louisiana, several unsuccessful attempts were made to introduce cane culture, but it was not until 1794 (three centuries after the first cane was brought over by Columbus) that the industry was established on a paying basis.

The processes of manufacture in the beginning were very primitive, and yet the essential stages of the process were the same as now; first came the crushing of the stalks and expression of the juice; second, the evaporation of this juice; and third, the crystal-

FIG. 1.—Primitive sugar factory, Sicily.

lization and separation of the sugar. In all three of these stages the improvements during the last one hundred years have been greater than in all previous time, the great reason for which is that it is only about one hundred years ago that the steam engine was introduced into sugar manufacture.

After visiting a large modern sugar factory with its enormous steam-driven machinery, it is difficult for us to imagine how they secured power, previous to Watt's invention. In windy localities they often made use of wind-mills, and this source of power is still largely utilized in Barbados. Where water power was available the crushing of the cane was done by water wheels. Fig. 1 is an old illustration of sugar manufacture, as it was carried out in Sicily about 1570. The picture shows in detail all the processes of manu-

facture; the stalks of cane were brought in from the fields on mules, were chopped into small pieces and carried in baskets to a hopper, where they passed to a crusher driven by a water wheel. The crushed cane was squeezed in a screw press operated by man-power. The cane juice was then evaporated in a series of large kettles over the open fire; the thick mass of crystals which resulted was finally poured into conical moulds, where it solidified upon cooling. The loaves of raw sugar thus obtained were packed in bags and exported for refining.

Very similar to this were the early processes of sugar manufacture in the Western Hemisphere. Fig. 2 illustrates sugar manufacture, as carried out about 1630 in Brazil, when it was owned by the Dutch. In the distance is a sugar factory operated by water power.

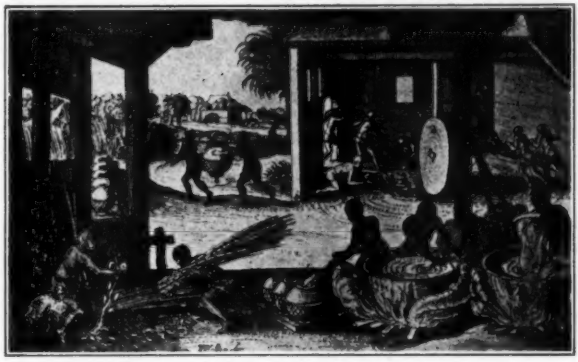

FIG. 2.—Primitive sugar factory, Brazil.

In the foreground is a stone mill driven by man-power; this is probably the oldest form of cane mill. The stalks were crushed between the heavy stone roller and the hard floor, the juice then being scooped up in pans and evaporated in kettles. The resulting mass of crystals was ladled into pots, which were then conveyed by natives to a cool place, where the sugar was allowed to harden.

Another old Dutch print of about the same time shows the interior of a sugar factory operated by water power (Fig. 3). The three vertical rollers for crushing the cane, and the method of transmitting power from the large water wheel will be noticed. In the foreground the operations of evaporating and filling the sugar moulds are shown. In the background is a second cane mill worked by oxen, this mill also consisting of three vertical rollers. In some

of these ox-driven mills the number of sweeps was increased to four or eight, so that several teams of oxen could be used; the power of the mill could thus be multiplied considerably.

The raw sugar made by these early methods of manufacture varied greatly in quality. The methods of clarification, before the days of chemical control, were naturally crude. One of the earliest and most available materials for eliminating the impurities of the juice was wood ashes. Milk was used as a clarifying agent as early as 600 A.D. in Persia, and it is interesting to note that milk is sometimes used for this purpose to-day in making maple sugar. As experience widened it soon became evident, however, that lime was the best and cheapest clarifying agent, and caustic or hydrated lime,

FIG. 3.—Early sugar factory, Brazil.[4]

which was used in Egypt as early as 700 A.D., is still the substance most universally employed. The evaporation of the cane juice was performed in open kettles over the direct fire, which method is always attended by caramelization and darkening of the sugar.

The elimination of the mother liquor, or molasses, from the crystals of sugar was not attempted in many early processes of manufacture, just as is the case to-day in primitive countries. For example, the Philippine concrete sugar, made by evaporating the juice to a very thick magma, which, after hardening, is broken up, contains all the soluble impurities of the juice. The juice is sometimes evaporated only to a semi-solid consistency, as in the case of certain Jamaica sugars. Sometimes this semi-solid mass of crys-

[4] From Reesse's "De Suikerhandel van Amsterdam."

tals is poured into hogsheads having openings at the bottom for the drainage of the molasses. The residue of sugar in the cask, as made by this process, is usually termed *muscovado.*

In some raw sugar factories the semi-liquid mass of sugar crystals, or *masse cuite,* was poured into a conical mould having an opening at the point for the escape of molasses. The loaves of sugar thus made varied in color from yellow to nearly black. In some cases the loaves of raw sugar were whitened by packing them in wet clay. The clay absorbed the molasses by capillarity and left a loaf of sugar which was nearly white. It was recognized that the loss by this process, through solution of sugar, was considerable; nevertheless this crude method of refining was formerly quite common.

Most of the raw sugar made in tropical America during the early days was sent to Europe for refining. Before this time the refining monopoly of the Venetians had been broken, and had passed to Amsterdam, which held the supremacy in this branch of sugar manufacture for several centuries afterwards.

We come now to the birth of the modern sugar industry, which may be said to date from 1806, when Napoleon announced his famous blockade of the continent of Europe against England. While his famous edict failed in its main purpose, it had a great influence in other ways, for it stimulated manufacturing and the arts to an unprecedented degree. In order to relieve the hunger of the people for sugar, heroic efforts were made to devise a substitute. In some parts of Europe, as Bohemia, maple sugar was manufactured, but the yield was not sufficient to supply even local demands. The famous chemist, Proust, then devised a process for obtaining the crystallizable sugar, dextrose, from grape juice. Another chemist, Kirchhof, also invented a process at this time for manufacturing dextrose from starch, and efforts were begun to establish a new starch-sugar industry. Dextrose, however, lacked the sweetening power of sucrose, and the consumers of sugar refused to content themselves with such a substitute.

About 50 years before this a German chemist, Margraf, had succeeded in isolating sucrose from the juice of the beet. Another chemist, Achard, followed up this discovery and in 1800 built a small factory for obtaining beet sugar on a commercial scale. The new industry, however, did not prosper at first and it was not until some ten years later that improvements made in France showed possibili-

ties of success. Napoleon at once ordered large tracts of land to be set aside for beet culture. Under his powerful patronage and the guidance of the best scientists of the time, several factories were erected and the new industry was soon established upon a prosperous basis.

The overthrow of Napoleon and the abolition of the blockade opened again the markets of Europe to the supplies of tropical cane sugar and it seemed for a long time as if the new beet sugar could not compete with cane sugar, the cheaper product of tropical slave labor. French statesmen, however, were far-sighted enough to protect the new industry with bounties and tariff regulations, so that the manufacture of beet sugar increased. The financial difficulties which the industry encountered stimulated greater improvements and economies in agriculture and manufacture. This policy, after fifty years, placed the beet-sugar industry far ahead of its rival. The cane-sugar industry, temporarily handicapped by the abolition of slavery, was in its turn forced to make improvements, and this it could do only by adopting the newer inventions and discoveries that had been worked out in beet-sugar manufacture. It is worth our while to mention a few of the most important improvements which have been made in sugar manufacture since the foundation of the beet-sugar industry.

The first improvement was the vacuum pan, invented by the English refiner, Howard, in 1813. Previous to that time, sugar juices had been boiled in open kettles at high temperature, with great losses of sugar by inversion and caramelization. By boiling the sugar solution in a closed apparatus, from which the air had been pumped, the temperature of evaporation was greatly reduced; losses from inversion and caramelization were prevented, and a much whiter sugar was obtained. The efficiency of the vacuum pan was afterwards increased by the addition of the condensing column, which was invented by Davis in 1829. The condensing column consists simply of an upright pipe, some 35 feet or more in height. Cold water passing downward through the pipe condenses the vapors from the vacuum pan; this condensation, aided by the barometric weight of the water column, produces a high degree of vacuum.

Another great invention, of about that time, was the multiple effect, devised by a native of New Orleans, Norbert Rillieux. He conceived the idea of evaporating sugar juice, not in one but in several vessels, and of so connecting these that the hot steam from

the evaporating solution in the first effect boiled the solution in the second, and the steam from the second effect boiled the solution in the third, and so on. By increasing the vacuums in the effects as the heating power of the steam diminished, it was found possible to boil off the water in a number of vessels by the heat which was supplied to the first unit of the series. The original patent of Rillieux, No. 4879, December 10, 1846, gives the following description: "A series of vacuum or partial-vacuum pans so combined together as to make use of vapor from the evaporation of the juice in the first to heat the juice in the second, and the vapor from this to heat the juice in the third, which latter is in connection with a condenser, the pressure in each succeeding one being less." The original evaporator of Rillieux was a triple effect and this is now probably the most common form of multiple evaporator, although there are quadruple, quintuple and even sextuple effects. Where more than three effects are joined, the juice in the first unit is usually boiled under, or slightly above, atmospheric pressure, in order to supply sufficient heat for carrying through to the last member of the series.

In 1835 the great French physicist, Biot, invented the polariscope, and no single piece of laboratory apparatus has done more to advance the science of sugar manufacture. It was possible, now, to determine sugar quickly and accurately and the foundation stone of chemical control in sugar manufacture was thus laid. More than this, the polariscope made it possible to analyze quickly the sugar beets used for seed selection. By selecting for seed each year the beets of highest sugar content the sugar percentage of the beet has been raised from 8.8 per cent. in 1838 to 18.1 per cent. in 1908, or more than doubled.

In 1844 the centrifugal was invented by Schotler and now it became possible to eliminate the molasses from the magma of sugar crystals in a few minutes, whereas months were consumed by the old process of drainage. In 1853 the filter press was invented by Needham and it was possible now for the first time to filter off the impurities of the clarified juice with neatness and dispatch. It is thus seen that, within twenty years, four great epoch-making inventions were introduced into sugar manufacture: the multiple effect, the polariscope, the centrifugal, and the filter press.

The appliance that we think of as most peculiarly connected with beet-sugar manufacture, the diffusion battery, was of comparatively late origin and was not introduced until 1864, by Jules Robert.

Previous to that time, the juice of the beets had been removed by pressing the ground pulp; the diffusion battery accomplished the extraction so much better and cheaper that its adoption became universal within a few years.

In 1884 Wulff perfected the crystallizer, a machine in which thick mixtures of sugar and molasses could be slowly rotated while cooling. The sugar crystals were in this way brought constantly into contact with fresh portions of liquid and were thus built up at the expense of the sucrose dissolved in the molasses. Previous to this invention, crystallization took place by allowing the mixture of sugar and molasses to stand for weeks and months.

The abolition of slavery in the West Indies, Cuba, Louisiana, and other tropical sugar-producing countries, and the consequent loss of cheap labor, at first caused the cane-sugar industry a serious setback. This loss was aggravated by the favoring bounties and protection which the beet-sugar industry received. In order to compete with its younger rival the cane-sugar industry found it necessary not only to avail itself of all the improvements which the beet-sugar industry had developed, but to strike out in new directions of its own.

The greatest loss in cane-sugar manufacture has always been the inability of the mills to express all of the sugar from the cane. Attempts to apply the diffusion process to the cane industry had to be abandoned, simply for the reason that the residue of cane fibre was left in so wet a condition that it could not be used for fuel. The lack of coal and cheap fuel in the tropics makes it necessary for the cane-sugar industry to depend upon the extracted fibre, or bagasse, for generating steam for engines and evaporators.

The two great improvements which the cane industry had to develop for itself were better bagasse burners and better mills, and these two appliances stand in most intimate relationship, since the better the mills the drier and more combustible the bagasse. In the old days of weak mills, and before blowing engines were used, the bagasse was so moist that it had to be dried in the sun before it could be used for fuel; in case of rain it had to be raked under shelter and spread out again when conditions were favorable. This process is still followed in primitive countries. In the most modern factories the bagasse is transported by carriers directly from the mill to the boilers, where it is burned by a forced draught from blowing machines; the combustion is perfect and the supply of bagasse is sufficient to supply all the fuel for operating the factory.

In the improvement of sugar-cane mills a great amount of effort has been and is still being spent. The cane mill is one of the most fascinating of engineering problems and one which has exercised the ingenuity of the greatest inventors. Such men as Henry Bessemer, the inventor of Bessemer steel, and John Hyatt, the inventor of celluloid, have patented methods for crushing and grinding sugar cane. Without going into a description of the various inventions, it need only be said that the employment of the steam engine and the hydraulic press has enabled inventors to increase the grinding capacity of cane mills many thousand fold beyond that of the old ox-driven machines, and with much more efficient extraction.

Let us now follow hastily the course of sugar from the time it leaves the field until it is bagged for shipment, basing our observa-

FIG. 4.—Harvesting cane in Cuba.[5]

tions on modern Cuban practice. When the sugar cane has reached the proper stage of ripeness, which in Cuba occurs in December, the operation of harvesting begins. The cane is cut entirely by hand, as shown in Fig. 4, this first step of the process having undergone no real change since the industry began. Harvesting by hand is expensive, yet inventors have spent their lives and fortunes in efforts to perfect a cane harvester. The great difficulty lies in the irregular growth of the cane, the stalks in some cases being so crowded and intertwined that the field is an impassable jungle. Consider also the mechanical complications of a machine to cut the cane close to the ground, strip the leaves, and clip off the green top, while wasting none of the valuable part of the stalk. Several inventors have almost

[5] This and the following illustrations are from photographs by the American Photo Company, Havana, Cuba.

solved this problem, and the one who first succeeds will be enrolled among the great benefactors of the sugar-cane industry and, incidentally, will reap a considerable fortune.

The cane is next piled by hand upon carts and hauled to the factory. In the old days oxen or mules were the sole means of transportation between field and mill, and the area upon which a factory could draw for its supply of cane was limited by the hauling distance. Since the advent of the steam railroad, cane is now sometimes hauled fifty miles or more to the factory. The ox-teams deliver the cane to cars at the nearest siding, where it is transferred by hoists, as shown in Fig. 5. When enough cars are filled, a train is made up and

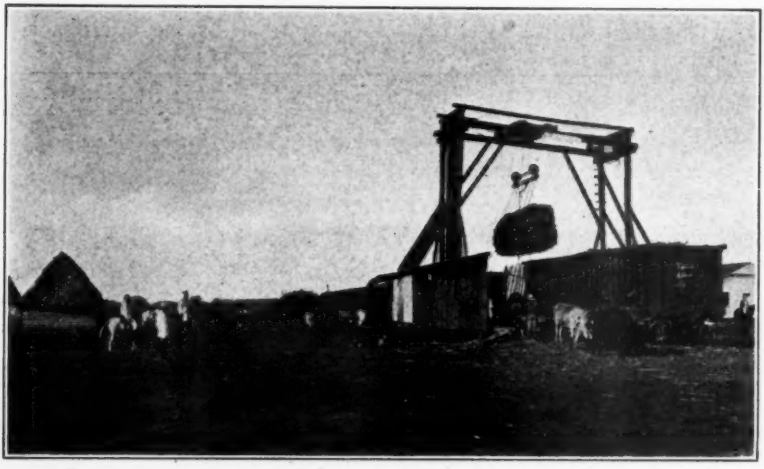

FIG. 5.—Loading cane on steam trains.

hauled to the factory. This method of transporting has vastly increased the cane areas upon which a factory may draw, and has rendered possible the erection of those large central establishments, some of which manufacture 50,000 or more tons of sugar in a season. One estate owns over 100 miles of railroad, and has some 1000 cars and 20 large locomotives. A train despatcher and force of signalmen are needed to keep trains moving with regularity.

The grounds before one of these factories resembles a large freight yard with its numerous tracks and switches (Fig. 6). As the trains of cane arrive, the cars are rapidly switched to the proper stations and are emptied by mechanical means to a large conveyor, as shown in Fig. 7. The conveyor carries the cane up a long incline

and the mass of tangled stalks finally falls between two huge corrugated rollers forming the crusher. This reduces the stalks to an even blanket of pulp and squeezes out at the same time a large

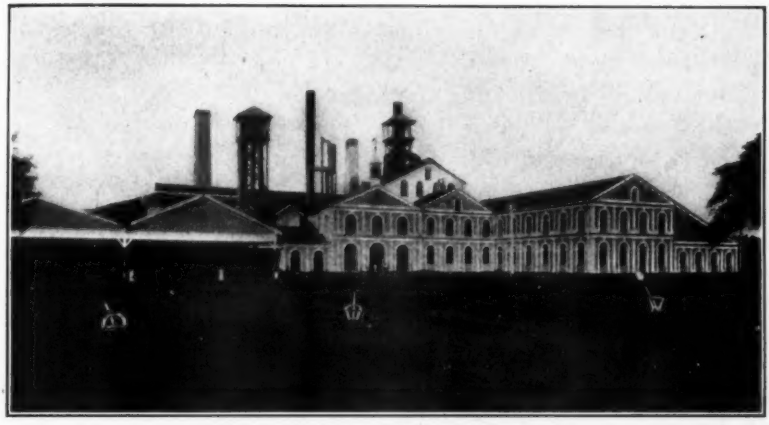

FIG. 6—Yard of a Cuban sugar factory.

FIG. 7.—Dumping cane at factory.

amount of juice which flows away at the bottom (Fig. 8). From the crusher the cane passes to the first mill, which consists of three powerful rollers, two below and one above; it is next conveyed to

a second and a third mill, and in some cases to fourth, fifth, and sixth sets of rollers; in the latter case there would be 18 rollers in the milling plant in addition to the two rollers of the crusher. Between the mills a thin stream of water is sprayed on the cane, which, being eliminated by the succeeding rollers, carries with it more and more of the residual sucrose. This process is called maceration and requires to be carefully controlled.

The pressure on the mills is gradually increased, as the cane advances, by powerful hydraulic presses; when the fibre leaves the

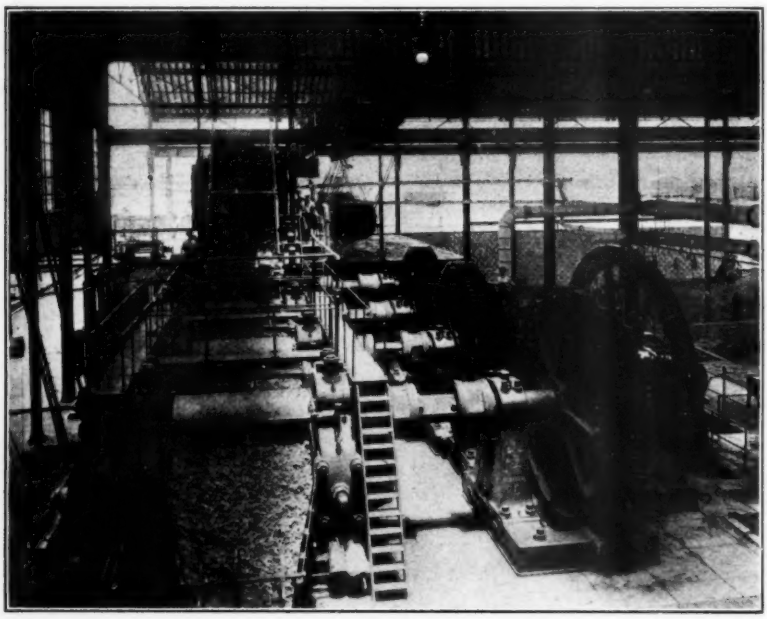

FIG. 8.—Roller mill.

final rollers it still contains between 40 and 50 per cent. of moisture (usually nearer 50 per cent.) with a small residue of unextracted sugar. The best mills extract over 95 per cent. of the total sugar in the cane.

The expressed juice from the crusher and mills is then pumped into tanks, called defecators, where it is treated with milk of lime to neutralize its acidity; after this it is heated to boiling by steam coils. The lime combines with the organic acids of the juice to form insoluble compounds, and the heat coagulates the albuminous

matter. A flocculent precipitate is formed, which partly rises to the surface to form a blanket of scum and partly settles to the bottom as a sediment. After standing a short time the clear juice is drawn off, while the sediment and scums are passed through filter presses and washed to remove adhering sugar, the runnings from the presses being then added to the main body of clarified juice (Fig. 9).

The clarified juice is next evaporated in the multiple effect to a syrup, which is then further concentrated in a vacuum pan to the point at which the sugar separates as a thick mass of crystals, the *masse cuite*. The latter is then purged in the centrifugals, the sugar remaining behind and the molasses escaping.

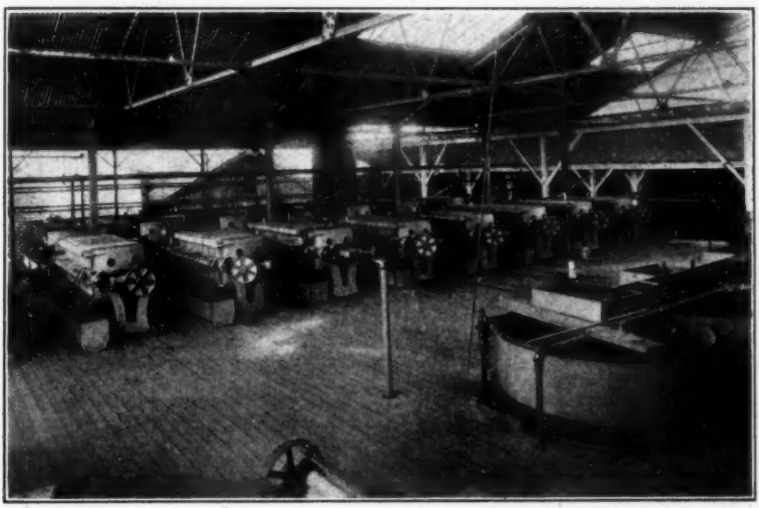

FIG. 9.—Filter presses.

The general lay-out of a modern sugar factory may be seen from Fig. 10, a view taken from the top of the cane mill. The bagasse from the last rollers falls upon a conveyor, which carries it to the burners. The defecators for clarifying the juice are at the left. In the distance, on a high platform, is a triple effect and on the same level is the vacuum pan, which is connected with a high condensing column. Underneath the vacuum pan are the crystallizers and centrifugals.

The molasses which escapes from the centrifugals still contains a considerable quantity of sucrose, and many processes have been devised to reduce this amount to the minimum. Owing to the accu-

mulation of soluble impurities, such as invert sugar, salts, amids, gums, etc., in the molasses, and the high viscosity, the sucrose crystallizes out with much greater difficulty than from the original evaporated juice. In order to promote the crystallization, use is made of crystallizers (Fig. 11). The molasses is sometimes boiled down to a second crystallization and then emptied into the crystallizer, where it is slowly stirred by revolving arms. Or a certain amount of molasses may be drawn into the vacuum pan and boiled down with

FIG. 10.—Interior of sugar factory, general view.

the *masse cuite* from the pure juice, the whole being afterwards run into the crystallizer. Whatever the process, of which there are many modifications, the crystallizer simply facilitates the building up of crystals by keeping the particles of sugar always in contact with fresh portions of molasses. When the crystallization is finished, as is determined by analyzing a sample of the filtered mother liquor, the contents of the crystallizer are run off into centrifugals, the sugar purged, and the waste molasses pumped into tanks, from which it is usually sent to distilleries. The utilization of molasses was described in the *School of Mines Quarterly,* July, 1913.

The sugar is dumped from the centrifugals into conveyors which carry it to chutes, where it is loaded into bags, and then placed in the warehouse ready for shipment. The Cuban bags of raw sugar weigh 325 pounds each, or about seven to the ton. The raw sugar, testing about 96, is nearly all shipped to New York, Boston, Philadelphia, or New Orleans, where it is refined.

The great progress in sugar manufacture has been due not simply to the invention of better appliances in manufacture, but also, and

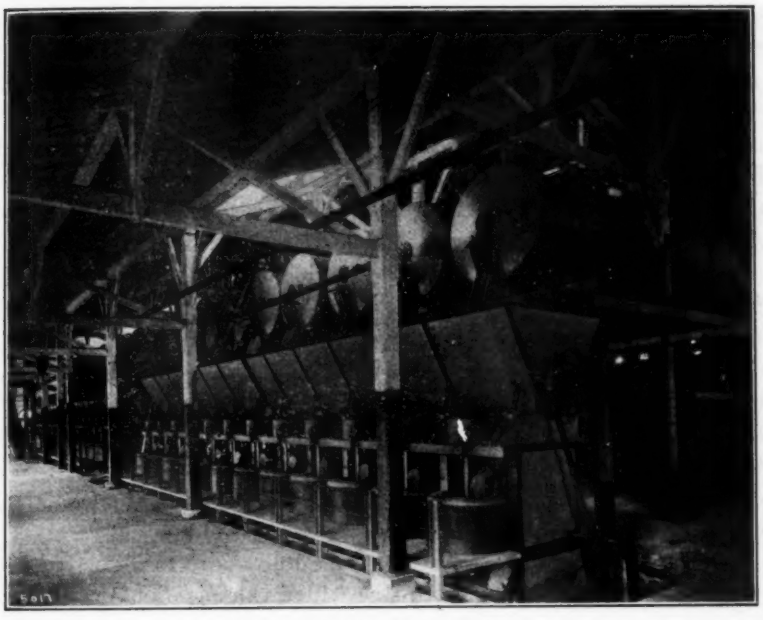

FIG. 11.—Battery of crystallizers.

in very large part, to the introduction of rigorous chemical control. The best appliances may do wasteful work unless constantly checked by strict chemical supervision. It is the duty of the sugar factory chemist to determine how much sugar enters the factory in the cane, and what percentage of this is obtained in the final product; to control the work of the mills by determining how much of the sugar in the cane is extracted and how much is lost in the bagasse; to control the work of clarification by determining the purity of the juice before and after defecation; to control the work of evaporating and boiling by checking losses from inversion or entrainment; to control

the work of the crystallizers by ascertaining that the final molasses has been reduced to the lowest possible sucrose content; and finally to control the quality of the raw sugar as to polarization, moisture, alkalinity, acidity, or any other factors which may affect the price or keeping quality of the product. Night and day, holidays and Sundays, the sugar factory chemists must be at their posts, for when the sugar campaign begins there is no let-up until the grinding season is finished. The moment a wrong turn occurs at any stage of the process, the fact must be quickly noted, lest large financial losses result.

The chemistry of sugar production has one other important side, which, unfortunately, is too much neglected. I refer to the chemical processes which take place where the cane is growing. We must never lose sight of the fact that the sugar which we eat is made in the field and not in the factory. If we determine all the factors that enter into the cost of sugar making, we shall find that about three-fourths of the expense is due to the agricultural operations of ploughing, planting, cultivating, and harvesting, and about one-fourth to the operations inside the factory. Strictly speaking, then, the agricultural side of sugar making should receive three-fourths of the attention bestowed by chemists and trained scientists. This has been largely true of the beet-sugar industry, a great part of the success of this branch of sugar making being due to the care given to chemical selection of seed and to other agricultural matters. The day is fast approaching when it will be equally true for the sugar-cane industry.

Unfortunately there still exists in some quarters a sort of contempt for that branch of chemistry which occupies itself with soils, fertilizers, tillage, irrigation, and the varied phenomena of plant life. This is a most narrow, mistaken point of view; the problems of agriculture are, in fact, the most important and most interesting in the whole field of applied chemistry, and the truly great chemists, such as Liebig and Humphry Davy, have recognized this. I predict that the opportunities of the chemist in the future will be found upon the agricultural side of sugar making, and that the ultimate goal in that field will be far more remunerative.

THE OXIDATION OF NITROGEN AND HOW CHEAP NITRATES WOULD REVOLUTIONIZE OUR ECONOMIC LIFE.[1]

By Dr. W. W. Strong.

How is Atmospheric Nitrogen Oxidized?

It is not many years ago (1898) that Sir William Crookes sounded the note of alarm concerning the possibility of a future famine in the world's supply of nitrates and other nitrogen compounds. At that time the supply of these salts was largely confined to certain beds of guano and Chile saltpetre. During the past few years most important advances have been made in our knowledge of the fixation of atmospheric nitrogen, and some of the processes have been placed upon a purely commercial basis.

In addition to drawing on the air directly for nitrogen it has been found that large amounts of ammonia and other nitrogen compounds may be obtained as by-products from coal and peat in connection with the manufacture of coke, illuminating gas, and the metallurgy of iron. The treatment of various shales, peats, silts, and organic refuse often yields nitrogen compounds. The nitrogen in these substances has probably been derived from the atmosphere by one or more of the processes which will now be described.

The amount of nitrogen that enters into the plant and animal growth ("nomadic" nitrogen) has been estimated to be about 20 Gms. per square yard of land. Part of this is being constantly changed into nitrogen gas by the action of nitrifying and denitrifying bacteria. In nature an equilibrium is maintained between the action of these bacteria and the oxidization of nitrogen in the air by means of electrical discharges and the action of plants, such as clover. The natural processes of fixing nitrogen are therefore electrical and by the action of bacteria in the legume crops of clover and similar plants. In former geological times certain nitride and other chemical compounds may have been formed directly with the air nitrogen, but it is doubtful if any such direct chemical reactions take place at present.

The natural oxidation of nitrogen by electrical discharges takes place during electrical storms, the aurora discharges at high levels,

[1] Reprinted from *Science*, Dec. 18, 1914.

and possibly in a slight degree in the bombardment of the higher strata of air by cathode and similar rays, ultraviolet light, and possibly by other radiations. The disintegration of radium and thorium products yields a small amount of oxides of nitrogen. It has been estimated that in this way about 100,000,000 tons of fixed nitrogen are carried to the earth every year by rain water.

The other natural method of fixing atmospheric nitrogen is that of the action of bacteria in the root nodules of the clovers, peas, vetches, and other legumes. The chemical processes are very complicated and are at present unknown. This process is, however, of tremendous importance to the farmer, and is probably the cheapest method now known of obtaining nitrogen as a fertilizer. This method is, however, quite expensive, in that cloverseed is expensive and the raising of a crop of clover requires attention, time, and the exclusion of other crops. On the poor soils where humus is the most needed it is found very difficult to get clover to grow. Restoration of fertility to run-down soils by this method is, therefore, slow and expensive.

The commercial methods of manufacturing nitrogen salts include the cyanamide process, the direct synthesis of ammonia, the various nitride processes of making ammonia, and the electrical methods of oxidizing nitrogen.

A process that is being used commercially is that of treating calcium carbide with nitrogen gas, thus yielding cyanamide, which itself makes a good fertilizer. Although the reactions are known to be complex, they may be represented, as regards the end products, as follows:

$$CaO + 3\,C \rightleftharpoons CaC_2 + CO,$$
$$CaC_2 + N_2 \rightarrow CaCN_2 + C.$$

The latter reaction begins at 1000° C. or at even lower temperatures. The N_2 may be prepared by the Linde process or by passing air over hot copper. According to Caro, the energy consumption for fixing one ton of nitrogen (including making the CaC_2, azotizing, machine driving, grinding, charging, air liquefaction) is less than 3 H.P. years.

The direct combination of nitrogen and hydrogen into ammonia is very successful when done on a small scale with pure gases, but, so far as is generally known, this process is not being worked on a large scale. A German company, however, is planning to make large quantities of ammonia by this process.

The nitride (including the Serpek) processes have not as yet proven to be successful from the commercial point of view. It is quite possible that these methods may be used in connection with the manufacture of aluminum and other metals with which these chemical methods are intimately connected.

The Electrical Methods for Fixing Nitrogen.

Several electrical methods are used for oxidizing the nitrogen of the air into nitric acid and various salts of nitrogen. These methods all produce chemical reactions between gaseous oxygen and nitrogen in intense electric fields. Potential differences of thousands of volts are used, and in the arc methods large currents and high temperatures accompany the use of intense electric fields. In all these methods the aim is to have the electrical discharge take place in the gaseous oxygen and nitrogen and to eliminate as much as possible the effect of the metallic electrodes. Large arcs are therefore necessary when the electric current is large. In the Birkeland-Eyde method the arc is drawn out by a magnet; in the Schönherr process by a helical current of gas, and in the Pauling process by horn electrodes and currents of gas. In the author's method a corona current is used, and this seems to give the most perfect type of a purely gaseous discharge.

The various electrical processes give about the same order of efficiency when this is measured by the number of grammes of nitric acid produced per kilowatt hour of consumption of electrical energy. About 60 to 80 Gms. of nitric acid are formed per hour per kilowatt of electrical energy.

The Complexity of Chemical Reactions.

Although single atoms, ions, and possibly molecules have been isolated, the condition under which the isolation takes place is entirely unique, the particles travelling with a very great velocity. In general, chemical reactions will not take place under these conditions in any way that they can be studied individually. Our knowledge of chemical reactions is, therefore, entirely statistical, and our laws apply to a very large number of reactions. There are numerous instances where experimental evidence indicates that the chemical reactions are frequently complex. The speaker's work on the absorption spectra of uranyl and uranous salts indicated the possible existence of various intermediate compounds in chemical reactions in solutions.

In gases chemical reactions are undoubtedly much less complex

than they are in solutions, although here the reactions may not be as simple as they are sometimes represented. The spectroscope is beginning to show indications that the light centres are more numerous than the possible number of atom, ion, and molecule types. In the case of nitrogen we have various types of line spectra, and quite recently Grotrian and Runge [2] have made convincing claims that the so-called cyanogen spectrum is due to nitrogen. (These experimenters worked with large Schönherr arcs about a metre in length.)

Chemical Reaction Centres.

Under conditions such as exist in the arc, spark, or whenever the temperature is high, many kinds of "centres" may exist. These "centres" may be the sources of light and heat emission or absorption, the ions that show deflections by electric and magnetic fields, and the particles that take part in chemical reactions. It must not necessarily be assumed that the "centres" of the various physical phenomena are the same. They may be widely different.

Among the centres which may exist in arcs and sparks and which have been shown to exist in vacuum tubes are

$$\overset{-}{O_2},\ \overset{-}{O},\ \overset{+}{O},\ \overset{+}{O_3},\ \overset{+}{O_6},\ \overset{++}{O},\ O,\ O_2,$$
$$\overset{++}{N},\ \overset{+}{N},\ \overset{+}{N_2},\ \overset{+}{N_3},\ \overset{+++}{N},\ N,\ N_2.$$

Negative electrons also exist in comparatively large numbers.

The formation of nitric oxide in the electric discharge may take place in a large number of ways. Some of these possible chemical reactions are as follows:

$$O \left\{ \begin{array}{ll} +N+e+e+e=NO & (1) \\ +N=NO & (2) \\ +\overset{++}{N_2}=NO+N & (3) \\ +\overset{+}{N}=e+e=NO & (4) \\ +\overset{+}{N}+e=NO & (5) \\ +\overset{+}{N_2}+e=NO+N & (6) \\ +\overset{+++}{N_3}+e=NO+N_2 & (7) \end{array} \right.$$
$$\overset{+}{N_2}+\overset{-}{O_2}=2NO.$$

[2] *Phys. Zeit.*, June 1, 1914.

In the place of O we might place O_2, $\bar{O}_2$, $\bar{O}$, O, O_3, $\overset{+}{O}_6$, and $\overset{++}{O}$. We thus have 56 possible chemical reactions to represent the fixation of nitrogen. No doubt, only a few of these reactions actually take place, though all are possible, provided all these kinds of ions exist where the oxides of nitrogen are being formed.

The comparative probability of some of these reactions is very small, especially when more than two products take part in the reaction. Since the oxides of nitrogen are apparently not removed from the gases by the electric field, it is probable that the oxides of nitrogen centres are not charged. Hence it follows that reactions which involve the presence of an electron are improbable. The apparent fact that the reaction is "electrical" would indicate that the reactions $N_2 + O_2$ and $N + O$ are not probable. The latter is in accord with the view that active nitrogen consists of N and that N does not take any active part in the formation of oxides of nitrogen.

It seems quite probable, therefore, that the main reaction that results in the formation of oxides of nitrogen is

$$\overset{+}{N}_2 + \bar{O}_2 + 43{,}000 \text{ calories} = 2NO$$

This type of ionization is produced by cathode rays or rapidly-moving electrons, according to Thomson and others, and accordingly this equation would indicate that the oxidization of nitrogen is indirectly due to cathode rays. It may be for this reason that thermionic electron radiations may play an important rôle in the formation of oxides of nitrogen in the various arc processes. In contrast to the above reaction is the reaction resulting in the formation of ozone. Ozone must necessarily be formed under conditions where some O_2 is dissociated.

The above reaction may be only one of several reactions, and under different conditions of pressure and temperature these reactions may be of relatively quite different degrees of importance.

Efficiency of the Nitrogen-fixing Process.

We can get some idea of the inefficiency of the present methods of oxidizing nitrogen when we consider that when gramme molecular weights of the gases are used one has:

$$N_2 + O_2 + 43{,}000 \text{ calories} = 2NO$$

approximately. The amount of energy used in this reaction is therefore about $1.7\ (10)^{12}$ ergs for about 126 Gms. of nitric acid. Assum-

ing 80 Gms. of nitric acid to be made per kilowatt hour, we should have an energy consumption of about $5(10)^{13}$ ergs, or an efficiency of about 4 per cent.

Nitrogen Fixation and Our Economic Life.

The small percentage efficiency of the present methods for oxidization compared with the theoretical efficiency indicates that improvements in the present methods would yield most important results. At the present time sodium nitrate sells for about $45 per ton. If the efficiency of the oxidation method could be increased so that calcium nitrate could be sold for $6 or $8 per ton, it would change our economic life fundamentally. Food products would be greatly decreased in value, real intensive farming could be pursued, suburban homes could easily be made self-supporting, and "abandoned" farms could be reclaimed. Probably no other one scientific development would so materially add to the material well-being of the people as this.

One of the reasons for the high cost of living is the fact that our soil fertility is difficult to maintain. Continued cropping will eventually impoverish the most fertile soils if the crops are not replaced. Cheap nitrogen fertilizers will not only practically restore virgin fertility, but will permit of the continual removal of crops. In this way the percentage of the crops that can be removed from the soil will be very much greater than under present conditions.

The cheapening of nitrogen fertilizers will permit of doubling, trebling, or even more greatly increasing farm crops. In addition to these results, cheap nitrogen fertilizers will permit a very much greater percentage of crops to be removed from the farms. Cheap nitrogen fertilizers will also permit of the most intensive farming in the immediate vicinity of industrial centres, thus lessening the time and cost of food distribution.

Surely the problem of nitrogen fixation should appeal to every one interested in the conservation of our resources. Our waterfalls represent an equivalent of nitrogen salt continuously going to waste instead of being used. And, surely, work of this kind is of greater importance than the building of dreadnoughts or the training of armies.

HOOKWORM DISEASE.

The Use of Oil of Chenopodium in Its Treatment.[1]

By Murray Galt Motter, Technical Assistant, Division of Pharmacology, Hygienic Laboratory, United States Public Health Service.

Among the inconveniences entailed by the European wars is the failure of the supplies of thymol, used so largely in the southern hookworm campaign. As a substitute for this drug, now almost unobtainable, American wormseed oil (Oleum Chenopodii U. S. P.) has been suggested.

As indicated by the name, wormseed has long had a reputation as an anthelmintic. The plant from which the oil is distilled grows "in waste places from New England to Florida and westward to California." It has, however, been cultivated particularly in Maryland, and the oil has been known as Baltimore oil, in contradistinction to the western oil, which is no longer much of a commercial factor. While the oil is almost wholly a Maryland product, it is said that the seed is harvested in considerable quantities in Florida, where the plant is one of the most pestiferous of the weeds.

Renewed interest in the possibilities of American wormseed oil, especially against round worms, seems to date from the publications of Brüning, in 1906, who, with Gockel, Kobert, Linke, Schmitz, Thelen, and others, has investigated the pharmacology of the oil. The chemistry of oil of chenopodium has been studied in Germany by Wallach and others and in this country by Kremers and by Nelson, of the Department of Agriculture.

Clinically, its value, especially for the treatment of round worms, was well established. In 1912, Schüffner and Vervoort presented to the Fifteenth International Congress on Hygiene and Demography a paper in which they sought to demonstrate the superior advantages of oil of chenopodium in the treatment of hookworm disease as compared with other vermifuges. These authors, in the course of eight months, had given oil of chenopodium in 1457 cases. Giving eucalyptus oil a coefficient of 38, naphthol 68, and thymol 83, oil of chenopodium surpassed them all with a coefficient of 91.

Toxicologically, a search of the Index Catalogue and the Index

[1] Reprint from the Public Health Reports, vol. 29, No. 40, Oct. 2, 1914.

Medicus revealed but 12 published cases of poisoning by wormseed oil in something over 50 years, the first having been published in 1852 and the last in 1903. Of these cases 8 were fatal. The report of one of the fatal cases is cited by Wood, with the added comment: "It is plain that the wormseed was not the direct immediate cause of all these symptoms or of the fatal result." All of the reported cases, however, show a certain general similarity, indicating that the toxic action is exerted particularly upon the central nervous system. Salant, in a preliminary report of his studies on the pharmacology of this oil, notes the possibility of cumulative action, indicated by the fact that non-toxic doses, when repeated in a day or two, were fatal in the rabbit. In the reported cases of poisoning the dose appears to have been excessive and, in some cases, repeated. Brüning asserts that when properly used this remedy does not cause any unpleasant secondary actions, an experience confirmed by that of subsequent workers.

It is to be noted that oil of chenopodium is a paralyzant, rather than a parasiticide. It narcotizes the parasite, which must then be got rid of by free purgation. Moreover—and here it differs radically from aspidium and thymol—it is probably best administered with castor oil. In the case of aspidium and thymol the coincident or subsequent use of any oil is to be avoided, because, their constituents being soluble in oils, they are thereby rendered more toxic to the human subject. With reference to chenopodium, which in itself appears to be constipating, the castor oil does not add to its toxicity, but offers a ready method of ridding the host both of the parasites and the drug.

Schüffner and Vervoort administered 16 drops of oil of chenopodium with sugar every two hours for three doses. Two hours thereafter they gave a tablespoonful of castor oil with a teaspoonful of chloroform. Gockel gives the single dose as 8 to 16 drops, according to age—6 to 8 years, 8 drops; 9 to 10 years, 10 drops; 11 to 16 years, 12 drops; over 16 years, 12 to 16 drops. Should untoward symptoms arise, particularly inordinate sleepiness or depression, the chenopodium should be withdrawn at once, active purgation induced, and stimulation begun with strong hot coffee by the mouth or by the rectum.

Owing to its increased vogue in continental medicine, the demand for this product has increased in the past few years. Schimmel reports that the acreage put to wormseed increased from about 90 acres

in 1910 to perhaps 225 acres in 1912, while the yield rose from 2800 pounds in the former to 6700 pounds in the latter year. In view of the fact that October is the time of harvest and that, with the diminished or disappearing supply of thymol, the demand will probably be still further increased, every effort should be made not only to husband this year's crop to the best advantage, but to provide for a largely increased seeding next spring.

Physicians having hookworm cases under their care should give this remedy a thorough trial and report promptly their results in the medical journals. Case notes should be accompanied by information as to the sources of the oil used and, if possible, as to the method of its distillation; it has been alleged that chenopodium grown in different localities, and oils distilled by different processes have shown varying degrees of efficacy. For use in the South, where the plant grows as a weed, the possible efficacy of a decoction, made by boiling one ounce of the fresh plant in a pint of milk or water, administered in wineglassful doses, should be remembered and tried under careful supervision. Data of this kind should aid in rehabilitating a truly American remedy, said to have been used by the Indians as a vermifuge before the landing of Columbus, and in helping the American profession to do without some of the products which, hitherto, have been almost wholly "made in Germany."

BOOK REVIEWS.

ESSENTIALS OF BOTANY, by Charles E. Bessey and Ernst A. Bessey. With 306 diagrammatic illustrations. New York: Henry Holt and Company.

This new volume is to be considered as the eighth edition of the Essentials of Botany by Doctor Bessey, and is entirely rewritten. The book consists of three parts; namely, morphology, physiology, and the classification of plants. Morphology is considered in the first three chapters, which are devoted to the consideration of protoplasmic contents, plant cells, the tissues of plants, and the tissue system. This portion of the book is characterized by a number of laboratory studies and titles of books of reference, making it of great value in those courses where practical laboratory work is given. This is one of the excellent features of the book. The time has gone by when a course in botany can be considered adequate unless provision is made for a

number of practical studies of plants. If the exercises are reasonable and represent definite problems, these courses must have a cultural influence equal to the studies in mathematics and the classics. Under plant physiology a great variety of subjects are treated, of which the following may be mentioned, showing the rather comprehensive treatment by the author: Under nutrition are considered water, imbibition, osmosis, turgor, path of water, evaporation of water, root pressure, solutions, mineral nutrients, photosynthesis, carbohydrates, proteins, root nodules, hysterophytic plants, respiration, anaërobic and aërobic respiration, fermentation, temperature relations, effect of poisons. Under growth are considered the relation to nutrition, temperature, light. Under reproduction are considered asexual and sexual forms, behavior of chromosomes, diploid and haploid number, inheritance, Mendelism, natural selection, survival of the fittest, variations, mutations, evolution, phylogeny, plant breeding. Under movements are given hygroscopic movements protoplasmic movements, turgor movements, growth movements, nutation, tropisms, phototropism, geotropism, thigmotropism, chemotropism, hydrotropism. Under pathology we find physiological diseases and diseases due to parasites. In connection with this part of the book quite a number of experiments are outlined, and these are frequently indicated by illustrations which, although they are reduced considerably, nevertheless show the construction of the apparatus employed and the results likely to be obtained.

There is also a classification of the important plant constituents, which, though very brief, shows their nature and probably will cause students to investigate the subject further. More than one-half of the book is devoted to the classification of various plants and the consideration of the phyla or groups of plants. This is exceedingly well done and interesting, being supplemented with a large number of laboratory studies and numerous references to the important literature. While there are some who might feel that certain portions of this book might be more extended and more detailed, yet it is important to bear in mind that there are a great many students who do not wish to specialize in botany, and for them the ideal book is one which contains a sufficient amount of accurate and authentic information and which causes them to continue their interest in the subject. As an elementary text-book this new work of Bessey's is to be commended.

A Laboratory Manual of Qualitative Chemical Analysis for Students of Medicine, Dentistry and Pharmacy, by A. R. Bliss, Jr., of the Birmingham Medical College. Philadelphia and London: W. B. Saunders Company.

Of manuals in Qualitative Chemical Analysis there seems to be no end, and one wonders that authors will be willing to take their time in writing works which, as a rule, contain only another point of view or the usual matters of fact stated in a little different manner. The great interest and value of the present book is in the fact that it is more complete, showing that the courses of chemistry in the various professional schools are becoming more elaborate as time progresses. The book has been brought up to date with the inclusion of the newer medicinal substances, and these are considered under the various classes of compounds to which they belong. Valuable information is given concerning their solubilities, with special tests for their detection and usually some explanatory information. The tables for the separation of the elements are well worked out, and, with the cross references for identity tests, will be found quite valuable. The book consists of nearly 250 pages, and is supplemented by a good working index.

Food Products, by Henry C. Sherman. New York: The Macmillan Company. $2.25 net.

By virtue of the exceptionally rapid development of food legislation and the scientific investigation of certain important aspects of the composition and value of food substances during the past few years, there have been published a number of important books on these products. Many of them have much to commend them, but none are probably as comprehensive as this book of Dr. Sherman. It contains a vast amount of practical information which is not usually available and that will appeal to a wide circle of readers and investigators. The general plan is to devote a chapter to each important type of food covering (1) an account of its production and preparation for market, with such brief statistical data as will indicate the relative economic importance of the industry; (2) the proximate composition and general food value; (3) questions of sanitation, inspection, and standards of purity; (4) special characteristics of composition, digestibility, nutritive value, and place in the diet. Lists of references appended to the different chapters will facilitate the extension of the

work covered by the text along either chemical, economic, sanitary, or nutritional lines.

The contents of the book include: The Principal Constituents and Functions of Foods; Food Legislation; Milk; Cheese and Miscellaneous Milk Products; Eggs; Meats and Meat Products; Poultry, Game, Fish, and Shellfish; Grain Products; Vegetables, Fruits, and Nuts; Edible Fats and Oils; Sugars, Syrups, and Confectionery; Food Adjuncts and Unclassified Food Materials; Rules and Regulations for the Enforcement of the Food and Drugs Act; Food Inspection Decisions; Methods, and Standards for the Production and Distribution of Certified Milk; Meat Inspection Law and Regulations; and a Table of 100-Calorie Portions.

YEAR-BOOK OF PHARMACY, comprising Abstracts of Papers Relating to Pharmacy, Materia Medica, and Chemistry. Contributed to British and Foreign Journals. From July 1, 1913, to June 30, 1914, with the Transactions of the British Pharmaceutical Conference at its Fifty-first Annual Meeting, held in Chester, July 20–23, 1914.

The Year-Book of Pharmacy constitutes one of the very best works of reference on pharmacy. The abstracts are concise and contain the salient features of the various research papers. The volume also contains the scientific papers presented to the British Pharmaceutical Conference at the meeting in 1914. To the student and research worker this volume is indispensable as a reference book. The work is supplemented with a very complete index, and reflects credit upon J. O. Braithwaite, editor of the Abstracts; Reginald R. Bennett, editor of the Transactions, and Thomas Stephenson, compiler of New Remedies Section.

CURRENT LITERATURE.

ALGAL STALACTITES IN BERMUDA.[1]

The hills of Bermuda are formed of a friable limestone, which represents particles of calcareous sand, which in the early geologic history of this group of islands was drifted by the wind into elevated dunes and afterwards by water action was compacted into a harder, or a softer, lime rock. This native rock is sawed out of the hillsides

[1] John W. Harshberger, in *Torreya*, October, 1914.

and is used in the construction of house walls (large, thick blocks) or house roofs (large, thin slabs). When exposed to the air, this soft quarried rock hardens into a form of limestone, much like concrete in appearance. As in all limestone formations of any considerable thickness, caverns and underground tunnels are worn into the softer strata by the action of rain and underground water. Several caverns of this character are visited by tourists in Bermuda, and some of them have pools of salt water replenished by underground supplies from the ocean. There are limestone sinks, which represent caves, the roofs of which have fallen in. A number of these sinks are dry, others are filled with water. One of the most frequently visited of these depressions, filled with salt water, which comes underground from the ocean, is Devil's Hole, in which are kept a number of the characteristic fishes of the Bermuda archipelago, such as the grouper, the angel-fish, the red-snapper, and others equally celebrated. The walls of the Devil's Hole are rather steep, and in places overhanging, so that the fresh water from the rocks above drips into the pool beneath. Here were found stalactites from an inch to two inches in length and coated with a covering of blue-green algæ.

Several of these stalactites were broken off from the overhanging wall in Devil's Hole, June, 1905, and kept dry for subsequent study, but the material was overlooked until the present summer (1914), when a study was made of it. Small pieces of stalactite were crushed in water and examined under the microscope. The blue-green algæ, which alone were present, were identified with Josephine Tilden's [2] first volume of "Minnesota Algæ." The algæ found on this examination consisted of *Chrootheca Richteriana* Hansg., *Gleocapsa ærugi-nosa* (Carmichael) Kuetzing, and *G. gelatinosa* Kuetzing, *G. quarter-nata* (Brébisson) Kuetzing, and *Gleotheca linearis* Naegeli. Attached to a small red alga (not identifiable) which was fastened to a piece of stalactite was found *Microcystis flos-aqua* (Wittrock) Kirchner. The most abundant blue-green alga was *Chrootheca Richteriana* Hansg., which, according to Josephine Tilden, consists of a somewhat gelatinous plant mass, thick or more or less expanded, of a blue-green or yellowish color. The cells found in these masses are 18 to 24 microns in diameter, once to twice as long as wide, single

[2] Tilden, Josephine, "Minnesota Algæ," vol. i: "The Myxophyceæ of North America and Adjacent Regions, including Central America, Greenland, Bermuda, the West Indies, and Hawaii." Bot. Ser. viii, 1910.

or in pairs, with thick sheaths up to 6 microns in diameter. This species, figured by Miss Tilden, has been reported from Bermuda by Farlow and from Montego Bay, Jamaica, by Pease and Butler. Of the three species of *Gleocapsa* enumerated above, the following is the distribution recorded in the "Minnesota Algæ":

G. æruginosa, Greenland, New York, West Indies (Porto Rico).

G. gelatinosa, United States, West Indies.

G. quarternata, West Indies, Hawaii.

The note with reference to *G. æruginosa* in "Minnesota Algæ" is apropos: "West Indies. Forming a dark green layer on stone in cave. 'El Convento,' near Penuelas, Porto Rico (Sintenis)." *Gleocapsa quarternata* is described as forming a gray-green, mucilaginous coating on wet cliffs in Hawaii. The distribution of *Glotheca linearis* is given in "Minnesota Algæ," as: "West Indies. On damp walls of dam, Sharp's River, St. Vincent (Elliott)."

That these algæ are active in the formation of the stalactites is indicated by their close attachment to the surface of the stalactites in the Devil's Hole, Bermuda. They remove in the case of the carbonated waters, containing calcium bicarbonate $(CaHCO_3)_2$ in solution, the gaseous carbon dioxide, which is used by the blue-green algæ in photosynthesis of organic compounds, so that the stalactites are formed by the continual deposit of calcium carbonate ($CaCO_3$). Josephine Tilden has studied the formation of algal stalactites in the Yellowstone National Park, where such algæ as *Gleocapsa violacea, Phormidium* (*Leptothrix*) *laminosum, Schizothrix calcicola,* and *Synecococcus æruginosus* are active. Associated with the older part of the Bermuda stalactites, I found a small gasteropod mollusc (*Kaliella turbinata* Gulick), hid away in small holes, or irregularities of their surface. In conclusion, we find, by the study of the material from Bermuda, that other algæ are concerned in the formation of stalactites besides those described from Yellowstone Park, and if a comparative study were made of stalactitic material from all parts of the world, the writer has no doubt that the list of algæ concerned would be a respectable one.

Inexperienced Growers of Drug Plants Not Likely to Succeed.

The cessation of the harvesting and shipping of many crude drugs because of hostilities in Europe has caused a sharp advance in their market price. As a result, many individuals and firms have written

the U. S. Department of Agriculture inquiring about the possibilities of the American farmer growing drug plants profitably. The department's specialist in charge of drug-plant investigations has written a number of these correspondents that, although it is probable that a number of important drug plants could be grown profitably here if the present high prices continue, nevertheless there is a possibility of the early restoration of shipping facilities, and, in any event, the inexperienced grower of drug plants would be more liable to meet with failure than with success.

Some medicinal plants, says the department's specialist, may be grown as easily as ordinary garden crops; others, however, require the special knowledge and skill of a practiced gardener. There are many varying factors in the commercial production of drug plants. The constituents of many of them vary in quantity, according to the time of gathering and method of drying, and a knowledge of proper methods of harvesting and curing is absolutely essential for the production of drugs of high quality.

Even if the prospective grower possessed some knowledge of drug plants, beginning now, he could scarcely hope to harvest a crop before the late summer of 1915. In the case of some varieties he might even have to wait until the end of the second or third year after planting. Therefore, the farmer who began at once might not find himself with a supply of crude drugs on hand until after prices had returned to their former level.

In any case, the quantity of crude drugs required by the market is relatively small as compared with fruits, vegetables, or staple crops. Therefore, numerous or extensive plantings by individuals throughout the country might easily result in overproduction, which would cause a decline in the market price independent of the conditions abroad.

For successful production of drug plants on a commercial scale there must be an available market. Its accessibility must be considered above all things by the successful grower. The cost of production must be carefully estimated, and to this must be added the cost of packing and shipping to this market. The packing and shipping expenses might easily make the enterprise unprofitable.

Drug plants, to be profitably grown, should yield returns at least equal to those from other crops which may be grown on the same land. The farmer must determine that this is the case. The fact that much hand work is necessary in the production of most drugs is liable to make the cost of labor high.

Among the inquiries regarding drug plants addressed to the department have been requests regarding plants which cannot be produced in this country at all. Others that might be grown here are also produced in South America and other localities not involved in the war, where they can still be produced more cheaply than here.

There are, nevertheless, certain drug plants now produced chiefly in Europe which under suitable conditions may be grown in parts of the United States. Among these are the following:

Althæa, Anise, Belladonna, Burdock, Calamus, Caraway, Conium, Coriander, Dandelion, Digitalis, Elecampane, Fennel, Henbane, Horehound, Marjoram, Sage, Thyme, and Valerian.

Seeds of many of these plants may be obtained from the large seed houses. Even the above-mentioned, however, need peculiar conditions in order to thrive, for drug plants vary widely in their relations to soil and climate. Satisfactory yields can be expected only when the requirements of these plants are understood and met.

Of course, well-established companies, already engaged in similar work, and with gardeners possessing training and experience, could undoubtedly meet with more success in growing drug plants than the inexperienced individual. These companies would understand at the beginning many essential details regarding soil, climate, and desirable varieties. They would, however, have to prepare for unexpected changes in market values, and remember that the principal reason certain plants have not been previously raised here is that under normal conditions they can be more cheaply grown in Europe.

Good Soil for Colon Bacilli.

Charles Leon Cowles, a student in the Department of Biology and Public Health at the Massachusetts Institute of Technology, has been investigating means for detecting the presence of *Bacillus coli* in water. The position with regard to the identification of the bacilli is that they all look much alike, and, to tell the difference between them, it is necessary to apply some other tests. Stains, resistance to acids, and the ability to produce gas are among the methods of determining the species. Another way is to find foods or soils in which some particular species will grow. Of this kind of test, the mixing of lactose bile, obtained generally from the organs of oxen, has been a means of distinguishing between the *B. coli* and others, the medium being favorable to the growth of this particular bacillus.

The *B. coli* is an intestinal organism of man, and its presence in water may be termed the red flag for typhoid and other diseases, and, like the innocuous red flag at the railway crossing, is a warning of great danger. It is important, therefore, to gain some quick and reasonably accurate means of determining the presence of *B. coli* in domestic water supplies. The ordinary test with lactose bile media is not considered very delicate; in fact, some authorities have pronounced it only twenty per cent. efficient.

What Mr. Cowles has done is to add one to two per cent. of bicarbonate of soda to the medium, with the result that the *B. coli* grows rapidly and other forms slowly, besides which the soda will prevent the growth of moulds and spreaders, the latter quick-growing things that come, perhaps, from the atmosphere and cover and obscure the plate. The whole story, which already bears useful results, is but a report of progress, and is suggestive of the untouched fields for investigation that are here waiting for the biologist.—*Science Conspectus,* No. 2, 1914.

THE BRITISH PHARMACOPŒIA, 1914.

On October 1, 1914, the General Medical Council (the statutory authority for preparing and publishing the British Pharmacopœia) issued to the Press specimen copies of the new edition of the work, which on December 31, 1914, will come into force in Great Britain and Ireland, replacing the previous edition of 1898. A comprehensive preliminary survey of the new edition appeared in *The Chemist and Druggist,* October 3, p. 49, and further details in succeeding issues. In the *Chemist and Druggist Diary* for 1915 is described the chemistry and materia medica of the new work, which contains forty-three new articles and preparations, but 168 of the old monographs have been omitted, these including several from the Indian and Colonial Addendum.

One of the most striking features of the Pharmacopœia is the evidence of its having been subjected to a boiling-down process. Drugs which are seldom used have been expurgated; crude products from which alkaloids are made are deleted, and in many cases only the active principles are given. The descriptions in the monographs are more terse and reduced to as few words as possible, often so as to remind one of Browning's style, vigorous but somewhat abrupt. Particles, pronouns, conjunctions, and even auxiliary verbs, are fre-

quently omitted, and many sentences occur without a verb in them. Nevertheless, this style does not uniformly characterize every monograph. The cutting-down process has also been applied in omitting altogether the references to illustrations of official plants. This may save a little room, but, from the botanist's point of view, is undesirable, as it leaves the reader in the dark as to the plant actually meant. Thus, the rose which yields otto is defined in some Pharmacopœias as the produce of *Rosa damascena,* Mill., and without the reference to the illustration it would be difficult to understand why the Pharmacopœia gives *Rosa damascena,* Linn., the fact being that the illustration quoted shows that it is not the typical *Rosa damascena,* Mill., which is a single rose, while the Bulgarian rose is semi-double, and is stated in " Pharmacographia " to be a variety of *Rosa damascena,* Mill., although Mr. J. G. Baker thought it near to *R. gallica.* Under these circumstances a figure that represents the semi-double character of the flower and the shape and size of the leaves gives a better idea of the plant than a description.

Senna is now indifferently the two kinds formerly known as Tinnevelly and Alexandrian senna, derived from two different species and regarded by most therapeutists as differing somewhat in strength. The statement is made that Alexandrian senna is usually smaller than Tinnevelly senna, but no other distinction between them is given, and this character applies not only to small varieties of Tinnevelly senna, but equally to the Mecca senna of commerce, which possesses the characters of both kinds, and is usually regarded as inferior to either the Tinnevelly or Alexandrian kinds. Under senna-pods no distinctive character is given for the two kinds. Again, *Alstonia constricta* and *Alstonia scholaris,* two barks very different in appearance, and used in different countries, are included in the same monograph under one name, so that if tincture of alstonia were ordered in this country one would hardly be certain to get a product uniform in character from two different drug houses or pharmacies, since one firm might use *A. scholaris* and another *A. constricta. Aloe,* which may now be one of three kinds, is practically in the same category.

Under oil of cajuput, the oil is said to be distilled from the leaves of *M. Leucadendron* and " other species of *Melaleuca.*" The words, " other species of *Melaleuca,*" allow the possibility of entrance into pharmacy of the Niaouli oil from *M. viridiflora,* Soland., which Messrs. Smith and Baker consider a distinct species, and that of

Melaleuca Smithii, R. T. Baker, the oil of which is said by those authorities to show " no resemblance to cajuput oil."

A few of the old drugs that have borne the test of centuries, such as galbanum, saffron, sarsaparilla, ficus, and conium, have now disappeared, the last-named a useful but in these days not well-understood remedy, while saffron cannot be said to have ever been regarded seriously from the physiological point of view. Mylabris and coca and jaborandi leaves are perhaps outside the domain of prescriptions, though all appear regularly in commerce, but these have now disappeared.

Under cascara sagrada and ergot the curious direction is given that the former should be collected at least one year before being used, and the latter should not be used if more than one year old, but how the pharmacist is to ascertain when the bark was collected in North America is not explained. The direction that ergot should not be used if more than one year old must leave the pharmacist in a quandary, since he cannot possibly tell (if the drug has been carefully dried) whether it was more than a year old when he received it. Belladonnæ folia consist now of the dried leaves, not the fresh leaves and branches, as in the last edition. This opens up the possibility of adulterated leaves from the Continent being used, the cheaper price of which will probably lead to a cessation of cultivation of belladonna in this country when the war is over. The requirement that the leaves should contain " 0.30 per cent. of alkaloids " is rather indefinite. That belladonna-root must be " the root collected in autumn and dried " indicates that probably English root is intended, but, in any case, the description given of the root would ensure its being autumn-collected, even if foreign root, since the spring-collected root is porous and almost free from starch.

Under catechu pallidum and catechu nigrum the statement is made that the crude drug should not yield more than 5 per cent. of ash, and the powder not more than 8 per cent.—a new official idea. The leaves of *Digitalis purpurea* are directed to be thoroughly dried at a " low temperature," but there is no explanation of what is meant by the word low. It is also directed that when powdered no portion should be rejected, probably so as to be in accordance with the published statement that the midrib is as active as the lamina. But digitalis leaves, retaining, as dried leaves usually do, about 12 per cent. of moisture, without which they cease to be pliable, are still open to the deteriorating action of their own enzymes, even if kept in a tight container. A tincture properly made from the fresh leaves, with

means taken to destroy the enzymes present, would probably give much better physiological results.

Under embelia the fruit of either *Embelia ribes* or *E. robusta* is allowed, but the commercial article nearly always consists of the fruit *E. robusta,* easily recognized by its longitudinally striated surface. Grindelia is now referred to *Grindelia camporum,* Greene, in accordance with the information published by Mr. P. E. F. Perrédès in 1909–10. Hyoscyami folia are now the dried leaves only, not "the fresh leaves and flowers with the branches to which they are attached," as in the last edition, nor need the leaves be obtained from the biennial plant. In this case also the boiling-down process seems to have been carried too far, since the inferior Continental annual henbane can be used, as no alkaloidal percentage is required. Kino is slightly lowered in quality, only 75 per cent. being required to dissolve in boiling water, as against 80 per cent. in the last edition. Kino eucalypti must, however, have 80 per cent. soluble in water, but whether hot or cold is not stated. Under menthol, *Mentha piperita* is no longer given as a source of menthol, although it may be included under "and probably other species of *Mentha.*"

Under myrobalanum, the official dried immature fruits are said to be usually distinguished in commerce as Chebulic myrobalans. This is not correct; they are distinguished as *black* Chebulic myrobalans, the mature fruit being larger and of a pale-brown color.

In Aid of Belgian Pharmacists.—The people of the United States are well aware of the devastation and havoc wrought by the unfortunate European War to the people of Belgium. The American people have as usual responded in a magnanimous manner to the appeals for food, and various organizations have been sending contributions for the assistance of their colleagues on the other side of the water. An appeal is sent out by a number of Pharmacists of Amsterdam, Holland, for the financial aid of the Pharmacists of Belgium and it is to be hoped that the Pharmacists of the United States will heed the appeal and render such assistance as they can to re-establish their colleagues of Belgium. Surely those of us who have visited this country will recall the hospitality with which we were received and probably no nation has rendered greater international service to Pharmacy than Belgium. Subscriptions will be received by the American Journal of Pharmacy and correspondence solicited that effective plans of relief might be perfected at once.